

[BoldFont=Fira Sans SemiBold]Fira Sans Book Fira Mono

popquizbox[1] colback=nipun-lightblue!10, colframe=nipun-blue,  
boxrule=2pt, arc=3pt, left=8pt, right=8pt, top=8pt,  
bottom=8pt, title= **Quick Quiz 1**, fonttitle=,  
**coltitle=nipun-white, colbacktitle=nipun-blue,**  
**enhanced, attach boxed title to top left=xshift=0pt,**  
**yshift=-2pt, boxed title style=arc=3pt, boxrule=0pt**

definitionbox[1] colback=nipun-green!8, colframe=nipun-green,  
boxrule=1.5pt, arc=2pt, left=6pt, right=6pt, top=6pt,  
bottom=6pt, title= **Definition: 1**, fonttitle=,  
**coltitle=nipun-white, colbacktitle=nipun-green**

examplebox[1] colback=nipun-orange!8, colframe=nipun-orange,  
boxrule=1.5pt, arc=2pt, left=6pt, right=6pt, top=6pt,  
bottom=6pt, title= **Example: 1**, fonttitle=,  
**coltitle=nipun-white, colbacktitle=nipun-orange**

keypointsbox colback=nipun-blue!8, colframe=nipun-blue,  
boxrule=1.5pt, arc=2pt, left=6pt, right=6pt, top=6pt,  
bottom=6pt, title= **Key Points**, fonttitle=,  
**coltitle=nipun-white, colbacktitle=nipun-blue**

As depth increases, train accuracy improves

As depth increases, train accuracy improves

As depth increases, test accuracy improves till a point

As depth increases, train accuracy improves

As depth increases, test accuracy improves till a point

At very high depths, test accuracy is not good (overfitting).

What causes high variance in a model? Give an example.

What causes high variance in a model? Give an example.

What causes high variance in a model? Give an example.

How does cross-validation help in model selection?

What causes high variance in a model? Give an example.

How does cross-validation help in model selection?



What causes high variance in a model? Give an example.

How does cross-validation help in model selection?

Why can't we directly optimize for test error?

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple
- **High Variance:** Overfitting, model too complex

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple
- **High Variance:** Overfitting, model too complex

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple
- **High Variance:** Overfitting, model too complex
- **Cross-Validation:** Essential for proper model evaluation



## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple
- **High Variance:** Overfitting, model too complex
- **Cross-Validation:** Essential for proper model evaluation

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple
- **High Variance:** Overfitting, model too complex
- **Cross-Validation:** Essential for proper model evaluation
- **Model Selection:** Choose complexity that balances bias and variance

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple
- **High Variance:** Overfitting, model too complex
- **Cross-Validation:** Essential for proper model evaluation
- **Model Selection:** Choose complexity that balances bias and variance

## Key Takeaways

- **Bias-Variance Decomposition:** Total error = Bias<sup>2</sup> + Variance + Noise
- **High Bias:** Underfitting, model too simple
- **High Variance:** Overfitting, model too complex
- **Cross-Validation:** Essential for proper model evaluation
- **Model Selection:** Choose complexity that balances bias and variance
- **No Free Lunch:** Cannot reduce both bias and variance simultaneously

## Next time: Ensemble Learning

- How to combine various models?

## Next time: Ensemble Learning

- How to combine various models?
- Why to combine multiple models?

## Next time: Ensemble Learning

- How to combine various models?
- Why to combine multiple models?

## Next time: Ensemble Learning

- How to combine various models?
- Why to combine multiple models?
- How can we reduce bias?



## Next time: Ensemble Learning

- How to combine various models?
- Why to combine multiple models?
- How can we reduce bias?
- How can we reduce variance?